Mitchell, S.W.

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TRANSMISSION

OF

ELECTRIC INFLUENCE

ACROSS THE MIDDLE LINE OF THE BODY

BY

S. WEIR MITCHELL, M.D.
OF PHILADELPHIA
MEMBER OF THE NATIONAL ACADEMY OF SCIENCES.

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ON THE TRANSMISSION OF ELECTRIC INFLUENCE

ACROSS THE MIDDLE LINE OF THE BODY.

By S. WEIR MITCHELL, M.D., of Philadelphia.

I HAVE met lately with certain interesting facts connected with the transmission of galvanic influence to remote parts, and across the middle line of the face. Some of these facts read clearly; others are less easy to interpret, and leave us face to face with unanswered questions.

I have noticed that in faradizing the chin or lips near ($\frac{1}{4}$ inch) the middle line, the muscle on the other side of the face, and nearest the mesial limit, may be made to contract. This is best seen in a face where, owing to unilateral facial palsy, the muscles on the diseased side do not themselves stir with the current; but it is also to be seen in health, although the muscles immediately under the conductors are apt, by their more powerful movement, to mask that of the muscles across the middle line.

I first saw this fact many years ago, but since then I have many times called upon my clinical assistants to notice it.

If we faradize the muscles, say on the left side of the face, through the facial nerve, we do not throw the right muscles into action, and to do so the conductors must be near the middle line. I have seen action in the right chin with the conductors $\frac{1}{2}$ inch from the middle line in a left-side palsy.

Far more interesting are the results obtained when we use a constant current, and when the patient is a case of complete uni-

lateral face palsy. When such a case occurs, as we all know, the power to stir the palsied muscles with induced currents fades, and at last ceases, and the response to constant currents becomes unusually good.

Before stating the phenomena to which I desire to draw your attention more fully, it may be well to describe the case which acted as the instrument of this little research.

H. S., æt. 62, Pa., March 16, 1876, stated that four weeks before he awakened with a slight loss of power in the left side of the face. Two weeks later this became entire. There was no marked deviation of the palatal arches, no auditory trouble or disturbance of taste; neither could I discover in his life, habits, history, or functional state any cause. The second attack came on with slight vertigo, which of course does not mean of necessity an intra-cranial trouble, but is met with at times even in sudden brachial palsies of a single nerve. The urine was healthy. The heart was feeble, but otherwise normal; the eye ground healthy. The muscular palsy was entire in every muscle of expression. The electrical examination was interesting.

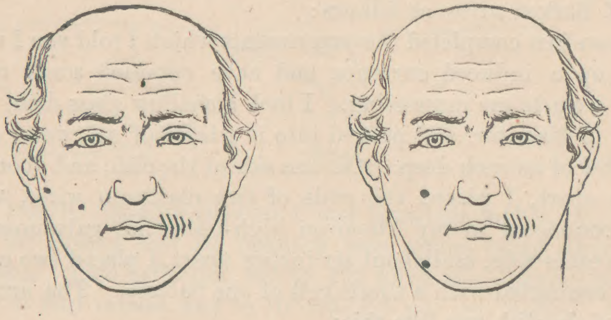
It was impossible to stir any muscle on the palsied side by any bearable induction current.

The sensitiveness of the palsied muscles to the constant current was, on the other hand, extreme.

One gravity cell moved the orbicularis oris on making circuit, but not on breaking it; but two cells acted on either making or breaking circuit, whilst six or eight cells moved every muscle on the left side freely. When the two poles with eight or ten or more cells, were placed on the sound side of the face, they caused no movement for half a minute or a minute when the current was made or broken, but almost at once gave rise to slight but increasing movement of the lip and chin muscles on the palsied side. These motions were most readily caused when the poles were near the middle line. As they were carried away from it the motion came later and demanded more cells. It was thus possible to move freely the orbic. oris when the nearer pole, whether negative or positive, was four inches from the left angle of the mouth, and on the sound side.

The position of the poles made little difference. The two might be in line with the angle of mouth, or at the two basal angles of a triangle, of which the corner of the mouth made the third, as illustrated in diagram 1.

I was somewhat inclined at first to suppose that this movement was due to reflex disturbance through the centres. This view was abandoned very soon, because it was found that galvanism of the sound nerve trunk under the ear, while competent, if powerful, to move the sound muscles, did not stir those of the left side,



and besides, the left nerve was incompetent to transmit the reflected impression. I concluded, therefore, that the movements caused were due to the action of currents induced between and beyond the two poles, and that these were enabled to excite the palsied muscles because of the acquired sensitiveness of these latter.

I was surprised, however, at the distance through which the area of competent currents spread, and to solve my remaining doubts I asked my friend Prof. Barker, of the University of Pennsylvania, to make certain experiments, which he has briefly described.

It is thus made clear by many observations, old and new, that extremely feeble currents may be competent to stir muscles when the nerve has been paralyzed, but this is only true of constant currents when made or broken ; no induced current stirs them.

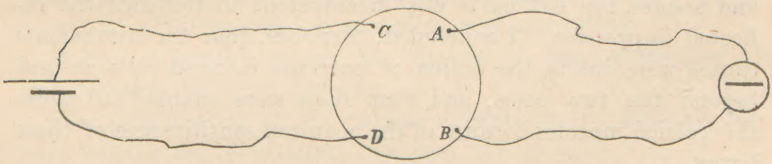
This is acquired knowledge, but that the constant current has power to move these palsied muscles when at a distance, I cannot find elsewhere stated, although it may be, as it is a most obvious phenomenon. Prof. Barker's experiments prove that the path of disturbed polarity between and beyond two conductors is surrounded by currents which freely move a galvanometer needle, the poles of which lie at right angles to the current and six inches distant. But this is not all. These currents which stir a muscle at four inches are, of course, induced currents ; but the induced

currents of our faradic batteries, enormously more powerful, cannot stir these muscles. How then do these two induced currents differ ?

I confess that in our present knowledge of electricity I can find no answer to this question, and to solve it will probably require a novel set of researches.

Prof. Barker writes as follows :

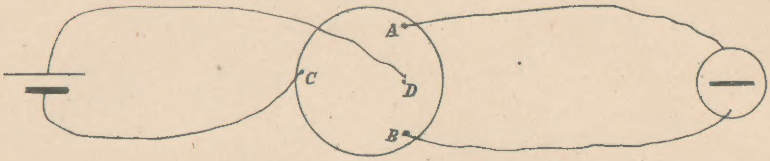
"I have just completed the experiments which I told you I would make upon induced currents, and have obtained some results which seem to me interesting. I took a shallow glass dish, eight inches in diameter, and poured into it a layer of salt water about a quarter of an inch deep. On one side of the dish, and about five inches apart, I placed the ends of two platinum wires, which were connected to my Thomson high-resistance galvanometer; on the other side, and about six inches apart, I placed two copper wires, connected with a single cell of the battery. The arrangement of the dish was like this:



"When the battery wire was introduced at D, a galvanometer deflection was observed of two hundred divisions of the scale. When removed, a similar deflection appeared, but in the opposite direction, and of one hundred and seventy scale divisions. That this deflection was due to an induced current was proved by the fact that the galvanometer deflection was not permanent. Moreover, the galvanometer was not affected on immersing the battery wires in the salt water, unless the zinc was immersed in the exciting liquid in the battery cell, showing that the presence of the copper wires in the salt water were without influence. I then reduced the distance between C and D to four inches; the deflection was one hundred scale divisions on closing, and sixty on opening the circuit. On diminishing the distance between C and D still more, *i.e.*, to two inches, the deflection on opening was twenty, and on closing fifty scale divisions. These results all point one way and show clearly that induction currents may be easily developed through imperfect conductors by very moderate currents,

and at considerable distances, the direction of the line of induction (from A to B) being parallel to that of the direct current (from C to D).

"To test the question when the two lines were perpendicular, I arranged the battery electrodes normal to the line joining the ends of the galvanometer wires:



"When the distance between C and D was six inches, the deflections on closing and on opening were equal, being sixty scale divisions. This deflection fell to 20° when the distance was reduced to four inches, and to 10° when it was two inches. But as a want of perfect perpendicularity between these lines will produce the effect of the former currents (being proportional to the cosine of the angle), I am not inclined to give these numbers as actual values."